IES Newsletter

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Director's Note

The Carriage House, behind the Perennial Garden, used to be a stable. In "A Gifford House Memory Sampler," Sally Gifford O'Brien wrote that the building had "six box stalls, a tack room, a three-car garage, a small tool room, the hay loft and a pigeon loft." When the Arboretum bought the property in 1974, the Carriage House was remodeled to provide storage space.

This structure has been completely renovated over the past six months by the Institute's very capable maintenance staff. Where there used to be storage areas for tools and equipment there is now an exhibit room where school groups learn about acid rain and where more educational exhibits will be set up in the coming months. Where there used to be a dingy, concrete-floored space to keep tractors and gardening supplies, there is now a bright, wood-floored classroom for IES Continuing Education Program classes. We hope that our students and visitors will enjoy this new education facility.

The IES Newsletter is published by the Institute of Ecosystem Studies at the Mary Flagler Cary Arboretum. Located in Millbrook, New York, the Institute is a division of The New York Botanical Garden. All newsletter correspondence should be addressed to the Editor.

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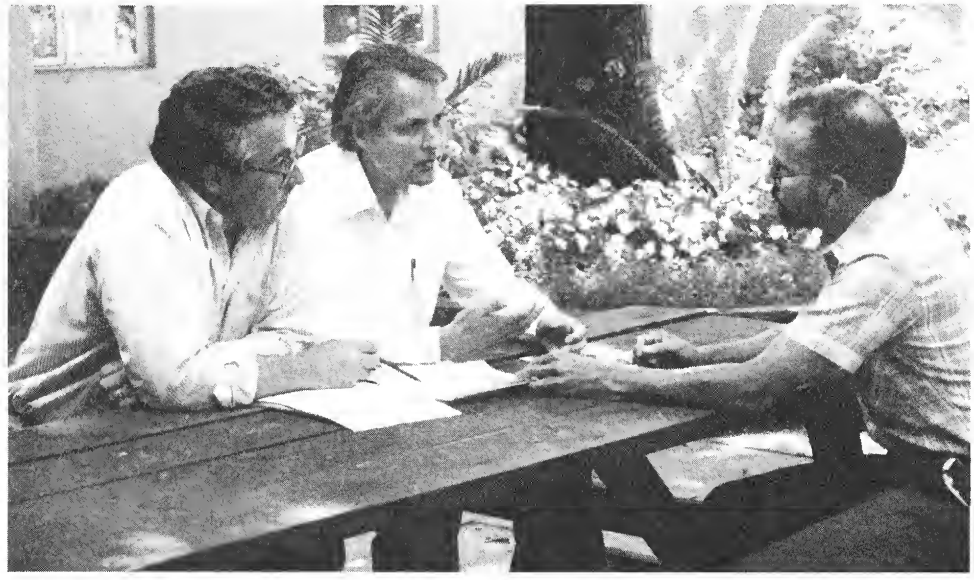
Exploring Human Impact on Landscapes

Fire . . .
Flood . . .
Grazing . . .
Humans . . .

. . . What do these have in common?

Although in one way this list looks as if it should be a "Which does not belong?" question from a child's workbook, these four things do have something in common: each has the ability to wreak havoc on an ecosystem. Ecosystem disturbance and recovery is an area of study for a number of ecologists at the Institute of Ecosystem Studies and elsewhere, and one ecologist who has directed his studies of ecosystem disturbance to focus on the effects of humans on landscapes is Dr. Eduardo E. Fuentes, the Institute's 1990 Cary Summer Research Fellow.



TOM TAFT

Drs. Mark McDonnell, Eduardo Fuentes and Steward Pickett worked together at an international workshop in Chile last January. In September, at IES, they planned future research in the field of landscape ecology.

Dr. Fuentes, a professor of ecology at the Pontificia Universidad Católica de Chile and Universidad de Chile, began his scientific career as an ecological zoologist, doing comparative field studies in the area around Santiago, Chile and in southern California. These two sites have very different biological histories but remarkably similar environments. Dr. Fuentes' goal was to learn more about ecological convergence, the phenomenon in which organisms from different regions develop similar characteristics due to adaptations and constraints imposed by similar environments. It was found that certain groups of organisms show ecological convergence while others do not, and Dr. Fuentes reasoned that indirect human effects, such as introduction of non-native species, could be part of the explanation for this discrepancy. Herbivory on seedlings by introduced rabbits, hares and goats in one area, for example, might explain differences in shrub communities between that area and one that is ecologically similar but without introduced herbivores.

Humans introduce non-native herbivores to a landscape. Humans also introduce annual grasses, and cause other major ecosystem disturbance by clearing and burning fields for agriculture. To try to determine more precisely the role of humans in the changing landscape, Dr. Fuentes shifted his research focus to landscape ecology which looks at the geographical expression of the relationship between cultural practices and biology. He is now studying changes in the central Chilean landscape since the arrival of Europeans some 500 years ago, and adding to his understanding of the historical role of humans by collecting data on the elimination of some species, the introduction of other species, the changes in plant cover and the erosion of soils.

What kinds of detective work are used to learn enough about landscapes to be able to recognize, and suggest causes for, changes that have occurred over centuries? Dr. Fuentes combines a number of techniques. He reads historical reports about how the landscapes used to look, and studies photographs from the past. He also compares disturbed sites with areas that look less disturbed and with similar ecosystems elsewhere in the world, to look for telltale differences.

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Research Experiences for Undergraduates, Part 2

Sophisticated student research. This phrase describes the three months of creative scientific thinking and hard work done at the Institute of Ecosystem Studies' laboratories by nine college undergraduates this past summer. In the last issue of the IES Newsletter, the research by three of these students was described: two of the students worked with Dr. Clive Jones and studied plants' chemical defenses against insects, while one worked with Drs. Margaret Carreiro and Steward Pickett to learn whether fungi — microorganisms that decay organic matter — grow more successfully in rural than in polluted urban areas. All nine students were participants in the third year of a Research Experiences for Undergraduates (REU) Program at the Institute, a program sponsored by the National Science Foundation (NSF) in its efforts to stimulate and support college student interest in the sciences.

Following are summaries of the work by the other students:

JENNIFER A. ALTRE, Cornell University, Ithaca, N.Y.
Mentor: Dr. Richard S. Ostfeld.

Meadow voles (*Microtus pennsylvanicus*) are small rodents related to lemmings, mice, rats, hamsters and gerbils. In the Northeast, female voles are aggressive and territorial while the males are less aggressive and tend to wander. During the summer voles are prolific, and as the population increases certain animals move to areas that are less desirable and therefore less inhabited. Which animals migrate to these new environments as the prime areas become too crowded? Ms. Altre's hypothesis was that adult males and juveniles of both sexes would be the ones to move, and she hoped that data resulting from her study would help determine how habitat patchiness relates to the social structure of these animals.

In the field site — an area near the Greenhouse with patches of pasture and little bluestem grass meadow — Ms. Altre laid out 169 live-traps in a grid 90 m (close to 300 ft.) on a side. Traps were set in the afternoon, baited with oats and provided with cotton so animals would be warm, then checked the following morning when the trapped voles were sexed, weighed, tagged and released at the site of capture. When she analyzed her nine weeks of data, Ms. Altre found differences between patches: while there was a greater population density, recruitment rate (influx of new voles due to reproduction or immigration) and probability of survival in the pasture, female territoriality was evident only in the meadow.

LAURA B. BYBEE, The University of the South, Sewanee, Tenn.
Mentors: Drs. Alan R. Berkowitz and Charles D. Canham.

IES ecologists studying growth of vegetation along utility company rights of way are interested in knowing if root systems of tree seedlings respond to environmental stresses by an increase or decrease in growth or branching frequency. Working in the Greenhouse, Ms. Bybee planted red oak and red maple seeds in sand, and grew the seedlings for a month. The plants were grown at normal and high shade levels, with normal and low amounts of nitrogen (administered in a nutrient solution) and with varying amounts of water. After harvesting the seedlings, which by then were 2.5 - 10 cm (1 - 4 in.) tall, Ms. Bybee washed, dried and weighed their roots. Seedling root system responses to stress (low levels of light, nitrogen and water) were evident, but not highly significant over short growth intervals. She found that root growth increased in response to both nitrogen and water stress (low levels of these growth resources), while it decreased at high shade levels.

SUSAN M. KAMINS, Antioch College, Yellow Springs, Ohio, and
EMILIO MAYORGA, Massachusetts Institute of Technology, Boston, Mass.
Mentors: Drs. David L. Strayer and Stuart E.G. Findlay.

Ms. Kamins and Mr. Mayorga worked on two different aspects of a section of the East Branch of Wappinger Creek at which a bend in the streambed allows a "detour" of water from the creek, through a gravel bar, and back to the creek. While the former looked at the interstitial (between sand grains or sediment particles), invertebrate and microbial communities, the latter measured the flow path and the chemistry of the interstitial water. Twelve Plexiglas wells (1.3 cm (0.5 in.) in diameter and 1 m (3.3 ft.) deep) were placed along a transect extending from the point upstream where stream water filters into the groundwater of

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DIANA R. LANE, Harvard University, Cambridge, Mass.
Mentors: Drs. Alan R. Berkowitz and Charles D. Canham.

What makes tree seedlings grow better or worse in any particular location? The answer to this question is being sought by ecologists with the Institute's long-term study of plant growth and ecological relationships along utility rights-of-way. The local conditions where the seedling grows may be an important determining factor, and Ms. Lane's study dealt with the plant's "microsite" to see how light, soil moisture and competition from neighboring plants might mean success or failure.

She worked with red maple seedlings because red maple trees are the most common invaders of rights-of-way in this area. Her microsites were 15 cm (6 in.) diameter circles around each seedling, and were established in three fields of varying moisture levels on the Arboretum. Her data showed that, within a field, variation in seedling growth did not correlate with variations within the microsites. Seedling response to overall differences in site quality, i.e., the light, soil moisture and degree of plant competition present in the whole field, superseded any pattern of response to microsite variation.

TOM TAFT

REU student Diana Lane and one of her IES mentors, Dr. Alan Berkowitz, test the Sunfleck Ceptometer that was used to measure light levels in the microsites.

REU Program, *from page 2*

the gravel bar to the point downstream where groundwater discharges back into the stream. All data were collected at these sites. The purpose of the study was to learn about the subsurface ecology of the gravel bar . . . the relationships between interstitial organisms and their physical environment.

Using sediment cores collected along the transect, Ms. Kamins determined the amount of microbial activity, collected the animals and identified them under a microscope, measured sand grain size, and noted the amount of solid organic matter that there was in the sediments. Her data showed that at the upstream end there are coarser sediments and larval and nymph forms of aquatic insects. Downstream, the sediments are fine, and nematodes — roundworms — are common. Copepods, mites and other microscopic crustaceans are found in both places. Ms. Kamins returned to school with data yet to be analyzed . . . data that she hopes will help to explain why there is little organic matter in the center of the gravel bar and why there isn't a continuum of change in the communities of gravel bar organisms.

Mr. Mayorga studied the physical and chemical characteristics of the groundwater. He measured water pressure differences at the wells to determine whether or not there was actual flow of the interstitial water, and found that the flow was considerable. Also, using a pump to collect water from the wells, he analyzed the water chemistry including the pH (level of acidity or alkalinity), dissolved oxygen, dissolved organic carbon and nitrates. Using this chemical data, he was able to determine several interesting things. First, changes in water chemistry from the upstream end of the bar to the downstream end showed the presence of an active subsurface biological community. Also, the data showed that interstitial water flow did, indeed, have its origin in the stream and was not due to infiltration by "true" groundwater from the adjacent stream bank.

Background data collected by Ms. Kamins and Mr. Mayorga will provide the foundation on which more detailed studies of the biological communities of shallow groundwaters will be based.

KRISTINA STINSON, Bennington College, Bennington, Vt.
Mentor: Dr. Clive G. Jones.

Changes in leaf chemistry following herbivore damage are known as "defensive" or "induced" responses. These changes have been shown to increase a plant's resistance to further herbivore attack by reducing insect preference for induced leaves. Ms. Stinson wanted to learn more about how insects respond to previous herbivory on plants.

TOM TAFT

The profile of the Plant Science Building has changed. A new roof, completed during the past summer, became necessary to correct serious leaks in the original roof. Architect Jim Flynn designed the new roof, and construction was done by R.W. Ciferri, Inc. of Millbrook.

Using cottonwood tree seedlings damaged by the willow leaf beetle or by mechanical means (a metal file), she observed the feeding behavior of adult leaf beetles on both types of damaged leaves and on undamaged control leaves. Regardless of the cause of the damage, the beetles preferred feeding on undamaged leaves. A similar pattern occurred in leaves closely connected (on the original plant) to damaged or control leaves. A theory is that leaf damage results in the release of phenol-glycosides, defensive chemicals found in some plants, and it is also possible that the cottonwood vascular system carries the phenol-glycosides throughout the plant.

* * * * *

A collection of the REU students' papers describing summer 1990 research and results, as well as reports of 1988 and 1989 REU studies, will be available as IES Occasional Publications.

Human Impact, *from page 1*

For example, in the Chilean mountains there used to be a belt of trees — a species of conifer whose wood was good for construction — that is now almost completely gone from the area near Santiago. Ecologically similar areas in Southern California and the Mediterranean each have a conifer belt. Why have seedlings survived and reached maturity there? A possible explanation is that in Chile, after the adult conifers had been cut for use in the building industry, rabbits and hares that had been introduced by European settlers moved into the newly opened areas and ate the seedlings, leaving no new trees to reestablish the forest.

Finally, Dr. Fuentes does experiments to see if past ecological conditions can be duplicated. Suppose he wants to explain why the seedlings of native shrubs are drying out in summer. He hypothesizes that fast-growing annual grasses introduced from Europe compete more successfully for water. He tests this hypothesis by growing the same seedlings under identical environmental conditions but without introduced grasses present. An interesting sidelight: Chilean farmers lend him the land, and often workers and materials as well, for his ecological field studies.

Dr. Fuentes was invited to apply for the Cary Summer Research Fellowship when he met IES ecologists Dr. Gene E. Likens, Dr. Juan J. Armesto (IES Adjunct Research Associate, Universidad de Chile) and Dr. Steward T. A. Pickett at an international workshop held early this year in Chillán, Chile (IES NEWSLETTER March-April 1990). He received the award and spent a month here in late summer, interacting with Institute ecologists on issues relating to landscape ecology, writing reports of his research and collaborating on two papers with Dr. Mark J. McDonnell. The latter were "ideas papers," Dr. Fuentes explained, about what landscape ecology is and how it could contribute to comparative studies of temperate evergreen rainforests in Southern Chile and the Northwestern U.S. The papers will be published as part of the proceedings from the Chillán meetings. Dr. Fuentes looks forward to continued collaboration with IES ecologists.

At the Greenhouse

During December, visitors to the greenhouse might look for the large and unusual ponderosa lemons (*Citrus ponderosa*) and bird-of-paradise flowers (*Strelitzia reginae*). In late January, the begonias of the Kolker Collection begin to bloom, while orchids start to flower in February.

The bird-of-paradise, a flowering plant that is native to South Africa, is blooming in the IES Greenhouse.

The IES greenhouse is a year-round tropical plant paradise as well as a site for controlled environmental research. There is no admission fee, but visitors should first stop at the Gifford House for a free permit.

Winter Calendar

CONTINUING EDUCATION PROGRAM

If you would like to receive a free catalogue of **Winter and Spring Semester** classes, workshops and ecological excursions but are not on our Continuing Education Program mailing list, please call the office at the number below.

SUNDAY ECOLOGY PROGRAMS

Free public programs are held on the first and third Sunday of each month, except over holiday weekends. Programs begin at 2 p.m. at the Gifford House on Route 44A unless otherwise noted.

There will be no program on December 16. Programs scheduled for January 6 and 20, 1991, as well as for February and March, will be listed in the next issue of the Newsletter.

IES SEMINARS

The Institute's program of **scientific seminars** features presentations by visiting scientists or Institute staff. All seminars are held in the Plant Science Building on Fridays at 3:30 p.m. Free.

Dec. 7: **Soil Microbial Nitrogen Dynamics in California Conifer and Grassland Systems**, by Dr. Mary Firestone, Univ. of California, Berkeley
Dec. 14: **Plant Microbial Interactions in Nutrient Cycling**, by Dr. Eldor Paul, Michigan State Univ., East Lansing
Jan. 11: Title to be announced. Speaker: Dr. Thomas T. Veblen, University of Colorado, Boulder
Jan. 18: **Recent Work in Understanding the Ecology of Land Mosaics: Boundaries, Corridors, Graph Theory, Fragmentation, and Land Conversion**, by Dr. Richard T.T. Forman, Harvard Univ.
Jan. 25: **Coping with Predictable and Unpredictable Habitat Deterioration: A Tale of Two Moths**, by Dr. Jeremy McNeil, Université Laval, Quebec

GIFT SHOP

Senior Citizens Days: On Wednesdays senior citizens receive a 10% discount on all purchases (except sale items).

Annual Pre-Holiday Sale: Friday, Saturday and Sunday, December 7, 8 and 9.

Please note: *The Gift Shop will be open on Saturday and Sunday, December 22 and 23 (see hours below) for your last-minute holiday shopping.*

Annual Holiday Clearance Sale, throughout January: 20% off on gifts and 10% on books, with 50% off holiday items and candles.

ARBORETUM HOURS

(Winter Hours: October 1 - April 30; closed on public holidays)

The **Arboretum** grounds are open Monday through Saturday, 9 a.m. to 4 p.m.; Sunday 1 - 4 p.m.
The **Gift and Plant Shop** is open Tuesday through Saturday 11 a.m. to 4 p.m. and Sunday 1 - 4 p.m. (closed weekdays from 1 - 1:30 p.m.).

All visitors must obtain a free permit at the Gifford House for access to the Arboretum. Permits are available up to one hour before closing time.

MEMBERSHIP

Become a member of the Mary Flagler Cary Arboretum. Benefits include a special member's rate for IES courses and excursions, a 10% discount on purchases from the Gift Shop, a free subscription to the IES NEWSLETTER, and parking privileges and free admission to the Enid A. Haupt Conservatory at The New York Botanical Garden in the Bronx. Individual membership is $30; family membership is $40. For information on memberships, contact Janice Claiborne at (914) 677-5343.

For more information, call (914) 677-5359 weekdays from 8:30 - 4:30.

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